

A Multiple U Slotted Rectangular Micro-strip Patch Antenna

Anshul Shrivastava¹ Abhinav Bhargava² Samrat Ghosh³
Technocrats Institute of Technology, Bhopal M.P.

Abstract-

In this paper we present a proposed design for Rectangular micro-strip patch antenna by cutting five U shaped slots in the Rectangular patch. Using proposed antenna design and probe feeding at proper position we find the resultant return loss, VSWR and bandwidth. We are using IE3D simulation software for designing and analysis. We have observed that using slotted patch antenna and using probe feed at proper location we can get better return loss, VSWR and bandwidth.

Keywords- Slotted U shaped Rectangular micro-strip patch antenna, return loss, VSWR, radiation pattern.

1. Introduction:-

Antenna is a key building in wireless communication and global positioning system(GPS) since it was first demonstrate in 1886 by Heinrich Hertz and its practical application by Guglielmo Marconi in 1901[1]. Future trend in communication design is towards compact devices. Low cost of fabrication and low profile features attract many researches to investigate the performance of a micro-strip patch antenna in various ways. Micro-strip antenna was first proposed by G.A. Deschamps in 1953. Micro-strip patch antennas are often uses where thickness and conformability to the host surfaces are the key requirements. Since patch antennas can be directly printed onto a circuit board, these are becoming increasingly popular within the mobile phone market. They are low cost, have a low profile and are easily fabricated. One of the key drawbacks of such device is their narrow bandwidth

[2]. Micro-strip patch antenna is widely considered to be suitable for many wireless applications, even though it usually has a narrow bandwidth [3]. The bandwidth limitation can be addressed by using thick substrates, cutting slots in the metallic patch, using aperture coupled stacked patch antenna [2]. The stacked patch antenna have multilayer structure consisting of several parasitic radiating elements placed one above the other and above the driven element[4]. However this approach has the inherent disadvantage of increased overall thickness and issues related on aligning various precisely. In this paper we design a rectangular micro-strip patch antenna in which five U shaped slots are cut. By cutting a slot in micro-strip patch enhance its bandwidth.

2. Antenna Design:-

The proposed antenna design by cutting five U shaped slots in Rectangular patch as shown in fig. (1). Cutting of theses slots in antenna increases the current path which increases current intensity as a result efficiency is increased. First a rectangular micro-strip patch antenna is designed based on standard design procedure to determine the length (L) and width (W) for resonant frequency. The resonant frequency of micro-strip antenna and the size of the radiation patch can be similar to the following formulas [6].

$$f = \frac{C}{2L\sqrt{\epsilon}} \quad (1)$$

$$W = \frac{C}{2f} \sqrt{\frac{2}{\epsilon+1}} \quad (2)$$

$$L = \frac{C}{2f\sqrt{\epsilon}} - 2\Delta L \quad (3)$$

Where f is the resonant frequency of the antenna, C is the free space velocity of the light, L is the actual length

of the patch, ϵ is the effective dielectric constant of the substrate and ΔL is the extended length. The dimension of the patch are $L=71\text{mm}$ and $W=52\text{mm}$. Inside this rectangular patch five U shaped slots are cut. The antenna is fabricated on a substrate of dielectric constant 4.4 and thickness $h=1.6\text{mm}$. The probe feeding is used for optimum results.

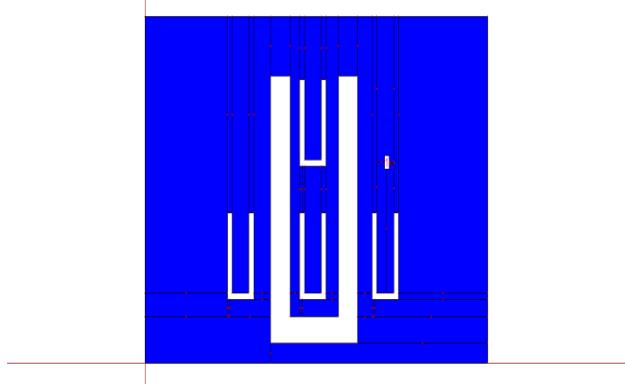


Figure (1): Proposed Rectangular Micro-strip Patch Antenna with multiple U shaped slots

3. Antenna Result:-

The simulation of micro-strip patch antenna is done by using IE3D simulation software. The variation of return loss with frequency of rectangular patch antenna with a five U shaped slots shown in figure (2). The return loss is defined as the ratio of the Fourier transform of the incident pulse and the reflected signal. It is an important parameter to reckon with [2]. The VSWR graph for a five U shaped slotted rectangular patch antenna is shown in figure (3). The VSWR indicates the mismatch between the antenna and the transmission line. For perfect matching the VSWR value should be close to unity. The simulation impedance bandwidth for the five U shaped slot loaded rectangular micro-strip patch antenna as shown in fig. (1) is 80 MHz and it is about 3.4% and the best return loss (S_{11}) is -31.36 dB at 2.39 GHz. The bandwidth is calculated at the frequency range where the return loss is approximately below the -10dB. The simulated radiation pattern in 2D are shown in figure (4) and the Smith chart is shown in figure (5) and radiation pattern in 3D is also shown in figure (6) for the

multiple U shaped Slotted rectangular micro-strip patch antenna.

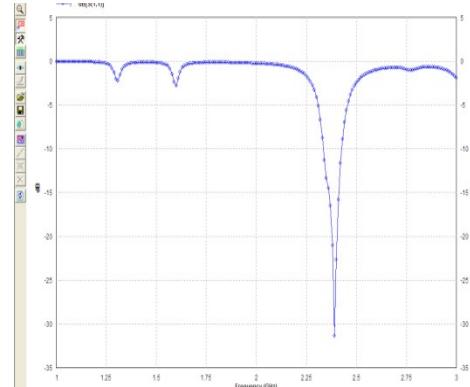


Figure (2): Return loss of the Proposed Rectangular Micro-strip Patch Antenna with Multiple U shaped slots

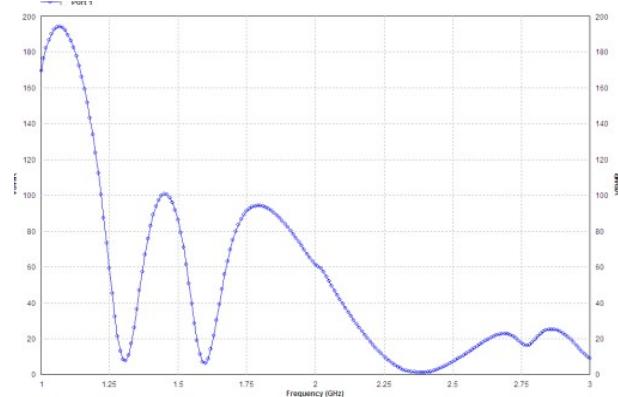


Figure (3): VSWR of the Proposed Rectangular Micro-strip Patch Antenna with Multiple U shaped slots



Figure (4): Radiation pattern in 2D of the Proposed Rectangular Micro-strip Patch Antenna with Multiple U shaped slots

and it can also use other wireless communication system.

5. References:-

- [1]. G.Papitha, V. Thyagarajan and AyshathulFouzia,"Design and Simulation of Stacked Fractal Patch Antenna using IE3D". International Conference on Computing and Control Engineering (ICCCE), 12 and 13 April 2012.
- [2]. John D Kraus, Ronald J Marhefka, Ahmed S Khan,"Antennas and Wave Propagation". Tata McGraw Hill Education Private Limited New Delhi 2010.
- [3]. R. Garg and P. Bhartia, "Micro-strip Antenna handbook". Boston Artech House 2001
- [4]. R.Q. Lee, K.F. Lee and J.Bobinchak,"Characterstics of a two layer electromagnetically coupled rectangular patch antenna", Electron Lett. Vol. 23 no 20, pp 1070-1072, 1987
- [5]. Binu Paul, S. Mridula, C.K. Aanandan and P. Mohan. Microwave and optical technology letters/ vol33, no4, 4 may2002.
- [6]. Constantine A. Balanis"Antenna Theory: Analysis Design" Third edition John Wiley & Sons, Inc 2005

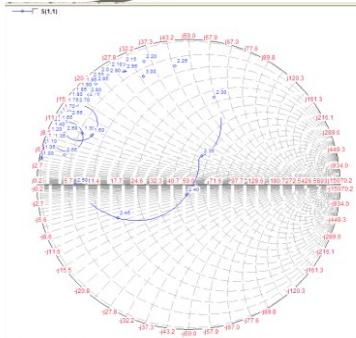


Figure (5): Smith chart of the Proposed Rectangular Micro-strip Patch Antenna with Multiple U shaped slots

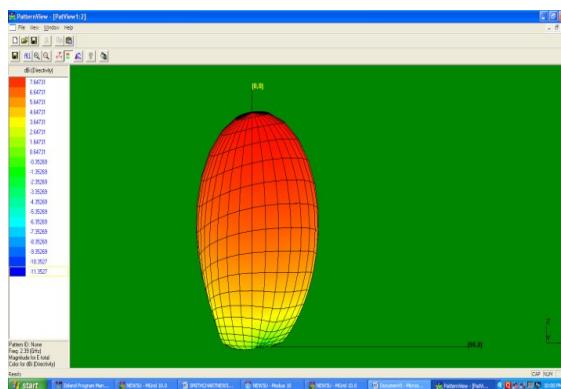


Figure (6): Radiation pattern in 3D of the Proposed Rectangular Micro-strip Patch Antenna with Multiple U shaped slots

4. Conclusion:-

It is observed that a probe feed, triple U shaped slotted rectangular micro-strip patch antennas is presented. The proposed antenna has a compact size of (71 x 52 x1.6) and it can effectively covers the Bluetooth application